the spectrum was seen here precisely as in the white parts of the aurora. I succeeded in making one good estimation of the position of the line from the red streamers, sufficient to identify it with that of the other measures made later on the white arch which was formed in the North-west after the corona and streamers had partially or wholly disappeared. This estimation gave $19^{\text{rev}}\cdot18$ as the position of the line. The subsequent measures give mean results of $19^{\text{rev}}\cdot03$ and $19^{\text{rev}}\cdot10$ respectively, which are believed to be tolerably close approximations, though not quite so satisfactory as had been hoped for.

No other lines were seen.

The extreme tenuity of the matter forming the aurora was demonstrated by the fact that Winnecke's Comet was visible with the 6½-inch refractor of the Observatory, through one of the densest streamers, without any other inconvenience than that of the brightness of the field of view.

*Durham Observatory, May 17th, 1869.*

---

## *On the Determination of Longitudes by Electric Telegraph.*

By E. D. Ashe, Commander R.N., Director of the Observatory, Quebec.

As I have had some experience in determining the longitude by electric telegraph, and, as it is likely to be useful to several of our Members in different parts of the world, I send an account of fixing the position "Rivière du Loup."

Sir William Logan (Director of the Geological Survey) requested me to obtain the latitude and longitude of "Rivière du Loup," which is about 130 miles below Quebec.

I started by railway on the 4th February; took with me a 24-inch transit; and a sidereal chronometer.

On my arrival, I called on the telegraph operator, who I found could not read by sound, and, consequently, I resolved to fix my transit-instrument in his garden, so that I should have only to take the chronometer into his office when I was ready to send signals.

I generally select a boulder, or get a large stone, upon which I place the instrument; erect a hut to keep the wind off; lead the telegraph wire into it; and, with a little portable telegraph-instrument that I always carry with me, I have all that is required when I am ready to send signals.

In this instance all the Earth was covered with snow for several feet in depth, and nothing like a stone for the support could be obtained; so I got a flour-barrel, removed the snow from the earth, and placed the barrel on the ground; then filled it with sand, poured two or three buckets of water over it and around it, and, as it was freezing, placed a square piece of board on the top; and as the thermometer was several degrees below zero, in a few minutes the whole was one solid mass. I then with boards built a hut.

I had to wait several days for a clear night, when I got the instrument into the meridian. As the country was covered with snow, and as all the fences are rails, you are sure of getting a "meridian mark" in some of the many posts. I had one about four miles off, a black line upon a white ground.

I have frequently been annoyed by boys, particularly in Upper Canada, where they are of the English type, who, when they see a light, commence throwing stones, and it is impossible to count seconds under those circumstances. On this occasion I heard one night a boy's voice, saying, "Please, sir, will you let any body in?" "No! but you may look through the crack." I cannot say if he took advantage of my kind offer; but if he did, he was as quiet as a mouse.

I got both latitude and longitude in the first four clear nights. After I had sent "time" to Quebec, I removed the transit-instrument, and drew a circle through the three points made by the three supports of the instrument, and moved one of the points 90° on the circle, and then I had the instrument on the prime vertical for latitude.

I was detained 19 days at the hotel waiting for clear weather. The expenses for travelling, building hut, paying operators at both ends of the line, amounted to 13*l*. This does not include remuneration for myself.

Quebec sent "taps" from the "mean time clock," commencing at the even minute, and continuing beating seconds until the 50 second in each minute, and this they did for six minutes. "Rivière du Loup" noted the "coincident tap" with the sidereal chronometer, marking the second and the series; and thus we had the difference of longitude to the hundredth of a second at once.

"Rivière du Loup" then sent "sidereal seconds" to Quebec, and this was repeated twice from each end of the line.

I cannot help thinking that this plan is the easiest and least troublesome, only requiring the telegraph line for half an hour, which is of great consequence.

The Latitude by Transit in Prime Vertical.

| | ° | ′ | ″ |
|---|---|---|---|
| α Aurigæ .. | 47 | 49 | 44 |
| 1071 B.A.C. .. | 47 | 49 | 45 |
| | | | 89 |
| Latitude of Rivière du Loup | 47 | 49 | 44·5 |

At Quebec 11 stars were observed for clock error,—7 stars, lamp west, and 4 stars, lamp east; deviation obtained by *Polaris* and ε *Ursæ Minoris*, and level frequently applied.

At Rivière du Loup 13 stars were observed,—7 lamp east and 6 lamp west. Deviation by *Polaris* and ε *Leporis;* and level frequently applied.

### 1st Set of Signals from Quebec.

| | h | m | s |
|---|---|---|---|
| Coincident tap sent by Q. at .. | 8 | 52 | 10·00 |
| Clock fast .. .. .. .. | | | −45·37 |
| Mean Time at Q. .. .. | 8 | 51 | 24·63 |
| Ditto at R. du Loup .. .. | 8 | 58 | 3·37 |
| Diff. Long. .. .. .. | 0 | 6 | 38·74 |
| Coincident tap noted at R. du Loup | 5 | 18 | 35·00 |
| Clock slow .. .. .. | | +1 | 1·71 |
| Sid. Time .. .. .. .. | 5 | 19 | 36·71 |
| Ditto at Mean Noon .. .. | 20 | 20 | 5·04 |
| Ditto since Mean Noon .. .. | 8 | 59 | 31·67 |
| Retardation .. .. .. | | 1 | 28·30 |
| | 8 | 58 | 3·37 |

### 1st Set from Rivière du Loup.

| | h | m | s |
|---|---|---|---|
| Coincident tap noted by Q. at | 9 | 28 | 5·00 |
| Clock fast .. .. .. | | | −45·37 |
| Mean Time at Q. .. .. | 9 | 27 | 19·63 |
| Ditto at R. du Loup .. .. | 9 | 33 | 58·38 |
| Diff. Long. 2d Set .. .. | | 6 | 38·75 |
| ,, 1st Set .. .. | | 6 | 38·74 |
| Coincident tap sent by R. du Loup | 5 | 54 | 36·00 |
| Clock slow .. .. .. | | +1 | 1·71 |
| Sid. Time at R. du Loup .. | 5 | 55 | 37·71 |
| Ditto at Mean Noon .. .. | 20 | 20 | 5·04 |
| | 9 | 35 | 32·67 |
| Retardation .. .. .. | | 1 | 34·29 |
| | 9 | 33 | 58·38 |

The next two sets of signals were turned into sidereal time, giving—

| | h | m | s |
|---|---|---|---|
| A Mean Difference of Longitude of | 0 | 6 | 38·70 |
| And the Grand Mean of the 4 Sets was | 0 | 6 | 38·725 |
| Longitude of Quebec .. .. | 4 | 44 | 49·02 |
| Longitude of Rivière du Loup .. | 4 | 38 | 10·295 |

*Observatory, Quebec, March* 4, 1869.